

EFFECTS OF DISSOLVED GAS SUPERSATURATION ON RESIDENT FISH

9602200

SHORT DESCRIPTION:

Evaluate the effects of dissolved gas supersaturation on resident fish downstream from Bonneville and above and below Ice Harbor Dams.

SPONSOR/CONTRACTOR: NMFS

National Marine Fisheries Service

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GOALS

GENERAL:

Supports a healthy Columbia basin, Adaptive management (research or M&E)

RESIDENT FISH:

Research, M&E

NPPC PROGRAM MEASURE:

5.6C.2;5.6E.1

RELATION TO MEASURE:

To properly administer spill as protection for juvenile salmonids; impacts to resident fish communities must also be understood and criteria set for their protection.

BIOLOGICAL OPINION ID:

NMFS FCRPS Biological Opinion Action No. 16

OTHER PLANNING DOCUMENTS:

National Marine Fisheries Service Snake River Salmon Recovery Plan Task 2.2.d.3 and 2.2.d.4 National Marine Fisheries Service Gas Bubble Disease Research Priorities Document

TARGET STOCK

All resident species

LIFE STAGE

MGMT CODE (see below)

BACKGROUND

STREAM AREA AFFECTED

Stream name:

Lower Snake, Lower Columbia

Subbasin:

Mainstem

Stream miles affected:

SRm 1-15, CRm 130-140

Hydro project mitigated:

Effects from spill produced by all projects.

Habitat types:

Riverine, Reservoir.

HISTORY:

In 1993, fish and invertebrates were sampled and examined for gas bubble disease (GBD) downstream from Bonneville Dam during the spring freshet; funded by the U.S. Army Corps of Engineers (COE) \$15K. In 1994, fish and invertebrates were sampled and examined for GBD, then held in net-pens for 4 days to evaluate changes in GBD signs and survival in the lower and

mid-Columbia River and the lower Snake River. Evaluations were continued throughout the period of spill provided for passage of juvenile salmonids; funded by the COE \$132.5K. In 1995 and 1996, sampling and holding activities similar to 1994 were conducted; funded by the COE \$188.2K, and BPA \$205.5K, respectively.

BIOLOGICAL RESULTS ACHIEVED:

Impacts of GBD to the aquatic biota in the reaches of highest dissolved gas have been evaluated by spill managers. Dissolved gas levels and durations of exposure which cause signs of GBD and mortality in captive fish and invertebrates have been documented and have been incorporated into a predictive model.

PROJECT REPORTS AND PAPERS:

Schrank, B. P., B. Ryan, and E. M. Dawley. (in preparation). Evaluation of the effects of dissolved gas supersaturation on fish in the mainstem Columbia and Snake Rivers, 1996. Report to the Bonneville Power Administration, Contract # 96-BI-93605, Project No. 96-022, 49p. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Schrank, B. P., E. M. Dawley, and B. Ryan. 1996. Evaluation of the effects of dissolved gas supersaturation on fish and invertebrates in Priest Rapids Reservoir, and downstream from Bonneville and Ice Harbor Dams, 1995. Report to the U.S. Army Corps of Engineers, Contract E96940029, (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Toner, M. A., E. M. Dawley, and B. Ryan. 1995. Evaluation of the effects of dissolved gas supersaturation on fish and invertebrates downstream from Bonneville, Ice Harbor, and Priest Rapids Dams, 1994. Report to the U.S. Army Corps of Engineers, Contract E96940029, 43p. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Toner, M. A., and E. M. Dawley. 1994. Evaluation of the effects of dissolved gas supersaturation on fish and invertebrates downstream from Bonneville Dam, 1993. Report to the U.S. Army Corps of Engineers, Contract DACW57-85-H-0001, E96940029, 23p + Appendix. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

ADAPTIVE MANAGEMENT IMPLICATIONS:

During periods of high spill over dams on the Columbia and Snake Rivers, results from this study may be used as an index to assess the impacts of gas supersaturation on salmonid (*Oncorhynchus* spp.) and resident nonsalmonid fish.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

During the periods of high spill, we will monitor the prevalence and severity of GBD by sampling resident fish downstream from Bonneville and Ice Harbor Dams and upstream from Priest Rapids Dam. The long-term goal of this study is refinement of a multiparameter model relating dissolved gas supersaturation levels (related to water flow and spill volumes) to signs of GBD and mortality in shallow-water fishes. Using regression analysis, we will compare duration and concentration of exposure to ambient dissolved gas levels with signs of GBD and mortality in organisms sampled from the river and held in net-pens.

CRITICAL UNCERTAINTIES:

Impacts to resident fish from GBD may be inconsequential or difficult to assess. Criteria based on faulty conclusions from resident fish sampling data could cause negative effects on measures taken to improve survival of migrating juvenile salmon.

BIOLOGICAL NEED:

To determine the relationship between the supersaturated dissolved atmospheric gases and the prevalence and severity of GBD in resident salmonid and nonsalmonid fish. Provide spill managers an index on impacts of GBD on resident fish during the spill season.

HYPOTHESIS TO BE TESTED:

Specific levels of supersaturation of dissolved atmospheric gasses cause gas bubble disease (GBD), which may be lethal to resident fish.

ALTERNATIVE APPROACHES:

Effects on resident fish could be ignored and effects of GBD on salmonids used as the only criterion for regulating spill at dams. We believe that the effects on resident fish are different and often greater than salmonids because of the duration of exposure to dissolved gas supersaturation. Severe impacts to resident fish populations could result from this narrower management perspective. A resident fish model relating dissolved gas levels to signs and mortality from GBD has been developed. However, confidence intervals are still quite broad for the mortality evaluation. More data are necessary to develop a more comprehensive and robust model.

JUSTIFICATION FOR PLANNING:

The potential of mortality unidentified by other means is a serious and unacceptable risk.

METHODS:

Weekly from each river reach (downstream from Bonneville Dam and Ice Harbor Dam and upstream from Ice Harbor Dam), up to 100 individuals of a targeted resident fish species will be collected and examined for signs of GBD. In some shallow areas, a 7.5-m 2-stick seine with 12.7-mm webbing will be used to collect fish. Along shorelines with a steep gradient, a 3.4-m-deep, 50-m variable-mesh beach seine will be used for sampling. In mid-channel, a purse seine will be used. The primary sampling method will be electrofishing using a boat equipped with a pair of adjustable booms fitted with umbrella anode arrays. All fish will be anesthetized, identified, measured to the nearest millimeter, and examined for external injuries and signs of GBD (subcutaneous emphysema on fins, head, eyes, and body surface). Fish will then be examined within 15 minutes of collection using a dissecting microscope with 15- to 40-power magnification. Specimens collected from each river reach will be held in net-pens and cages for 4 days, and then reexamined for prevalence of GBD. Analysis of variance will be used to determine relationships between dissolved gas levels, exposure duration, GBD signs, and GBD-related mortality.

PLANNED ACTIVITIES

SCHEDULE:

<u>Planning Phase</u>	<u>Start</u> January	<u>End</u> March	<u>Subcontractor</u>
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Task Coordination of activities with state, federal, and tribal fisheries agencies. Obtain permits and refine plans for dates and locations of sampling and testing.

<u>Implementation Phase</u>	<u>Start</u> March	<u>End</u> Sept.	<u>Subcontractor</u>
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Task Installation of holding and examination facilities. Starting the last week in March, fall chinook salmon emigrating from Spring Creek Hatchery will be sampled along with resident fish during the period of spill for fish passage. Thereafter, at the onset of spill in the three river reaches, fish will be collected and examined for GBD on a weekly basis. Most of the non-salmonids will be placed in net-pens and examined for GBD after a 4-day holding period. This will also be performed on a weekly basis. The 1998 field season is expected to be completed about mid-August.

<u>O&M Phase</u>	<u>Start</u> October	<u>End</u> Feb.	<u>Subcontractor</u>
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Task All facilities are temporary and will be disassembled in September. Following completion of sampling and testing, efforts will be directed to analysis of data and reporting results.

PROJECT COMPLETION DATE:

1998

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:

Changes in state water quality waivers might change the dates and amounts of spill. If in 1997, the refinement of the resident fish GBD model increases the precision of mortality predictions to an acceptable level, that model may replace the need for subsequent sampling and holding research. Handling mortality to juvenile salmonids of about 0.5% and to resident species of about 5%.

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:

Development of predictive model to index impacts to resident fish from dissolved gas supersaturation.

Present utilization and conservation potential of target population or area:

N/A

Assumed historic status of utilization and conservation potential:

N/A

Long term expected utilization and conservation potential for target population or habitat:

N/A

Contribution toward long-term goal:

Development of a predictive model for impacts to resident fish from dissolved gas supersaturation.

Indirect biological or environmental changes:

Cessation of sampling for effects of GBD.

Physical products:

NA

Environmental attributes affected by the project:

Reevaluation of requests for voluntary spill at dams.

Changes assumed or expected for affected environmental attributes:

N/A

Measure of attribute changes:

N/A

Assessment of effects on project outcomes of critical uncertainty:

Continued refinement of the model--at least one additional year of data--will protect against the potential of drawing faulty conclusions.

Information products:

Prevalence of GBD in resident fish populations that inhabit shallow water areas of the mainstem river, and an estimate of mortality from GBD.

Coordination outcomes:

Re-evaluation of spill volumes/dissolved gas levels in the mainstem river.

MONITORING APPROACH

(See Methods section)

Provisions to monitor population status or habitat quality:

The COE will be monitoring levels of dissolved gas.

Data analysis and evaluation:

Through statistical analyses comparing data sets from previous years and other locations.

Information feed back to management decisions:

Re-evaluation of recommendations to use model in lieu of continued sampling and testing .

Critical uncertainties affecting project's outcomes:

Research could be conducted to evaluate the abundances of resident fish species, thus evaluate impacts from GBD by examination of fluctuations in the population.

EVALUATION

Weekly reports of GBD in resident fish. Confidence limits on model parameters.

Incorporating new information regarding uncertainties:

Through discussions with investigators and contracting officer's technical representative.

Increasing public awareness of F&W activities:

Through dissemination of results.

RELATIONSHIPS
RELATED BPA PROJECT

9602400 GBD:changes in signs/effects on survival~

RELATIONSHIP

Examines the effects of experimentally administered GBD on in-river migration and survival, and potential changes in signs associated with passage through the bypass system of a hydroelectric dam

5501500 GBD monitoring of juvenile salmonids under FPC.

Evaluating the same river conditions on different stocks of fish.

OPPORTUNITIES FOR COOPERATION:

None at this time

COSTS AND FTE

1997 Planned: \$180,000

FUTURE FUNDING NEEDS:

<u>FY</u>	<u>\$ NEED</u>	<u>% PLAN</u>	<u>% IMPLEMENT</u>	<u>% O AND M</u>
1998	\$205,500		100%	
1999	\$0			
2000	\$0			
2001	\$0			
2002	\$0			

PAST OBLIGATIONS (incl. 1997 if done):

<u>FY</u>	<u>OBLIGATED</u>
1996	\$205,500
TOTAL:	\$205,500

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

<u>FY</u>	<u>OTHER FUNDING SOURCE</u>
1998	NMFS

<u>AMOUNT</u>	<u>IN-KIND VALUE</u>
\$100,000	\$20,000

OTHER NON-FINANCIAL SUPPORTERS:

None

LONGER TERM COSTS: None

1997 OVERHEAD PERCENT: 45.6% of total direct labor charges

CONTRACTOR FTE: 2 NMFS employees
